FORM PTO-1390 (REV 5-93) U S DEPARTMENT OF COMMEPCE PATE'T AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 225/49630

U S APPLICATION NO (if known, see 37 CFR 1 5): 09/763199

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP99/04535	01 July 1999	19 August 1998

TITLE OF INVENTION
Synchronizing Device for a Shift Transmission

APPLICANT(S) FOR DO/EO/US
MAIER, Winfried

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U S.C 371

2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U S C 371

3. [ ] This express request to begin national examination procedures (35 U S C 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).

4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2)).

   a [ ] is transmitted herewith (required only if not transmitted by the International Bureau)

   b [X] has been transmitted by the International Bureau

   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US)

6. [X] A translation of the International Application into English (35 U.S C 371(c)(2))

7. [X] Amendments to the claims of the International Application under PCT Article 19 (35 U S.C 371(c)(3))

   a [ ] are transmitted herewith (required only if not transmitted by the International Bureau)

   b [ ] have been transmitted by the International Bureau.

   c [ ] have not been made, however, the time limit for making such amendments has NOT expired

   d. [X] have not been made and will not be made

8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U S.C. 371(c)(3)).

9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)) **(UNEXECUTED)**

10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U S.C. 371(c)(5))

Item 11. to 16. below concern other document(s) or information included:

11. [X] An Information Disclosure Statement under 37 CFR 1.97 and 1 98.

12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. [X] A FIRST preliminary amendment

    [ ] A SECOND or SUBSEQUENT preliminary amendment

14. [X] A substitute specification

15. [ ] A change of power of attorney and/or address letter

16. [X] Other items or information:
Form PCT/IB/308

JC02 Rec'd PCT/PTO 20 FEB 2001

U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/763199	PCT/EP99/04535	225/49630

17. [X] The following fees are submitted·	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)):		
Search Report has been prepared by the EPO or JPO $860 00	$860.00	
International preliminary examination fee paid to USPTO (37 CFR 1.482) $690.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2) $710.00	$0.00	
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37CFR 1.445(a)(2) paid to USPTO $1000.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$860.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

Claims	Number Filed	Number Extra	Rate		
Total Claims	36-20=	16	X $18.00	$288.00	
Independent Claims	3-3=	0	X $80.00	$0.00	
Multiple dependent claims(s) (if applicable)			+ $270.00	$	

TOTAL OF ABOVE CALCULATIONS =	$	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).	$	
SUBTOTAL =	$1148.00	
Processing fee of $130.00 for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1 492(f)). +	$	
TOTAL NATIONAL FEE =	$1148.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28,3.31). $40.00 per property +		
TOTAL FEE ENCLOSED =	$.1148.00	
	Amount to be: refunded	$
	charged	$

a. [X] A check in the amount of $1148.00 for the filing fee is enclosed.
b. [ ] Please charge my Deposit Account No. ______ in the amount of $______ to cover the above fees. A duplicate copy of this sheet is enclosed.
c. [X] The Commissioner is hereby authorized to charge any additional fees, which may be required, or credit any overpayment to Deposit Account No. 05-1323 . A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
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Donald D. Evenson

SIGNATURE
Donald Evenson
NAME
26, 160
REGISTRATION NUMBER
February 20, 2001
DATE

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:
BRÜCKNER, Ingo
DaimlerChrysler AG
Intellectual Property Management
FTP-C106
D-70546 Stuttgart
ALLEMAGNE

FTP
Eing.:
UT., 13. März 2000
z. Erledigung | FTP/E | FTP/P | FTP/S
Frist

Date of mailing (day/month/year)	
02 March 2000 (02.03.00)	
Applicant's or agent's file reference	**IMPORTANT NOTICE**
28148/WO/1	

International application No.	International filing date (day/month/year)	Priority date (day/month/year)
PCT/EP99/04535	01 July 1999 (01.07.99)	19 August 1998 (19.08.98)

Applicant
DAIMLERCHRYSLER AG et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   EP,JP,KR,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   BR,MX

   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   02 March 2000 (02.03.00) under No. WO 00/11367

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, **a demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer J. Zahra
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

Form PCT/IB/308 (July 1996)

3127267

Attorney Docket: 225/49630
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WINFRIED MAIER

Serial No.: To be Assigned Group Art Unit:

Filed: February 14, 2001 Examiner:

Title: SYNCHRONIZING DEVICE FOR A GEARBOX

PRELIMINARY AMENDMENT

Box PCT
Commissioner for Patents
Washington, D.C. 20231

Sir:

Please enter the following amendments to the specification, claims and abstract prior to the examination of the application.

IN THE SPECIFICATION:

A marked-up substitute specification and a clean substitute specification is submitted herewith.

IN THE CLAIMS:

Please cancel all of the claims presently in the application and substitute new claims 12-47 therefor:

12. (NEW) Synchronizing device for a shift transmission, with at least one outer and one inner synchro ring and, if appropriate, at least one intermediate ring, the synchro rings

and the intermediate ring in each case having conical surfaces, via which they are connected at least indirectly to one another, and at least one of the synchro rings and/or the intermediate ring consisting of a metallic basic material, wherein at least one of the synchro rings and the intermediate ring consist of the metallic basic material which is nitride-hardened in such a way that, by process parameters being set during nitride-hardening, one of a non-metallic γ'-connecting layer and a non-metallic ε-connecting layer is formed on a conical surface of at least one of the synchro rings and the intermediate ring.

13. (NEW) Synchronizing device according to Claim 12, wherein a γ'-connecting layer is formed which consists of Fe_4N.

14. (NEW) Synchronizing device according to Claim 12, wherein a ε-connecting layer is formed which consists of $Fe_{2-3}N$.

15. (NEW) Synchronizing device according to Claim 12, wherein at least one of the synchro rings and the intermediate ring is plasma-nitride-hardened.

16. (NEW) Synchronizing device according to Claim 12, wherein the metallic basic material of at least one of the synchro rings and the intermediate ring is a sintered material.

17. (NEW) Synchronizing device according to Claim 12, wherein the metallic basic material of at least one of the synchro rings and the intermediate ring is a sinter-forged material.

18. (NEW) Synchronizing device according to Claim 12, wherein the metallic basic material of at least one of the synchro rings and the intermediate ring is a hardenable steel.

19. (NEW) Synchronizing device according to Claim 12, wherein the nitriding depth is 200 to 800 μm.

20. (NEW) Synchronizing device according to Claim 12, wherein the γ'-connecting layer and the ε-connecting layer is 1 to 20 μm, preferably approximately 10 μm, thick.

21. (NEW) Synchronizing device according to Claim 12, wherein the intermediate ring is arranged between the inner synchro ring and the outer synchro ring, the conical surfaces of the intermediate ring having a friction layer, and the γ'- or ε connecting layer being in each case located on the conical surfaces of the two synchro rings in the outer region.

22. (NEW) Synchronizing device according to Claim 12, wherein the inner synchro ring or the outer synchro ring is firmly connected to a gearwheel, the γ'- or ε-connecting layer being applied to one synchro ring, and the friction layer being applied to the other synchro ring.

23. (NEW) Synchronizing device according to Claim 13, wherein a ε-connecting layer is formed which consists of $Fe_{2,3}N$.

24. (NEW) Synchronizing device according to Claim 13, wherein at least one of the synchro rings and the intermediate ring is plasma-nitride-hardened.

25. (NEW) Synchronizing device according to Claim 14, wherein at least one of the synchro rings and the intermediate ring is plasma-nitride-hardened.

26. (NEW) Synchronizing device according to Claim 13, wherein the metallic basic material of at least one of the synchro rings and the intermediate ring is a sintered material.

27. (NEW) Synchronizing device according to Claim 14, wherein the metallic basic material of at least one of the synchro rings and the intermediate ring is a sintered material.

28. (NEW) Synchronizing device according to Claim 13, wherein the metallic basic material of at least one of the synchro rings and the intermediate ring is a sinter-forged material.

29. (NEW) Synchronizing device according to Claim 14, wherein the metallic basic material of at least one of the synchro rings and the intermediate ring is a sinter-forged material.

30. (NEW) Synchronizing device according to Claim 13, wherein the metallic basic material of at least one of the synchro rings and the intermediate ring is a hardenable steel.

31. (NEW) Synchronizing device according to Claim 14, wherein the metallic basic material of at least one of the synchro rings and the intermediate ring is a hardenable steel.

32. (NEW) Synchronizing device according to Claim 13, wherein the nitriding depth is 200 to 800 μm.

33. (NEW) Synchronizing device according to Claim 14, wherein the nitriding depth is 200 to 800 μm.

34. (NEW) A synchronizing device assembly for a vehicle shift transmission, comprising:

a first synchro ring with a first friction surface, and

a second synchro ring with a second friction surface which in use selectively engages the first friction surface,

wherein said first synchro ring is formed of a metallic base material, and

wherein said first synchro ring is nitride hardened to form one of a non-metallic γ'-connecting layer and a non-metallic ε-connecting layer on said first friction surface.

35. (NEW) A synchronizing device assembly according to Claim 34, wherein said first synchro ring is nitride hardened to form a non-metallic γ'-connecting layers of Fe_4N on said first friction surface.

36. (NEW) A synchronizing device assembly according to Claim 34, wherein said first synchro ring is nitride hardened to form a non-metallic ε-connecting layers of $Fe_{2-3}N$ on said first friction surface.

37. (NEW) A synchronizing device assembly according to Claim 34, wherein said first synchro ring is plasma-nitride-hardened.

38. (NEW) A synchronizing device assembly according to Claim 34, wherein said first synchro ring is formed of a sintered material.

39. (NEW) A synchronizing device assembly according to Claim 34, wherein said first synchro ring is formed of a sinter-forged material.

40. (NEW) A synchronizing device assembly according to Claim 34, wherein said first synchro ring is formed of a hardenable steel.

41. (NEW) A synchronizing device assembly according to Claim 34, wherein the nitriding depth on the first synchronizing is between 200 and 800 μg.

42. (NEW) A synchronizing device assembly according to Claim 34, wherein the connecting layer is between 1 to 20 μm thick.

43. (NEW) A synchronizing device assembly according to Claim 34, wherein the connecting layer is 10 μm thick.

44. (NEW) A method of making synchronizing device assembly for a vehicle shift transmission, comprising:

a first synchro ring with a first friction surface, and

a second synchro ring with a second friction surface which in use selectively engages the first friction surface,

said method comprising forming said first synchro ring of a metallic base material, and

nitride hardening said first synchro ring to form one of a non-metallic γ'-connecting layer and a non-metallic ε-connecting layer on said first friction surface.

45. (NEW) A method according to Claim 44, wherein said first synchro ring is nitride hardened to form a non-metallic γ'-connecting layers of Fe_4N on said first friction surface.

46. (NEW) A synchronizing device assembly according to Claim 44, wherein said first synchro ring is nitride hardened to form a non-metallic ε-connecting layers of $Fe_{2-3}N$ on said first friction surface.

47. (NEW) A synchronizing device assembly according to Claim 44, wherein said first synchro ring is plasma-nitride-hardened.

REMARKS

Entry of this preliminary before examination and calculation of fees of the application is respectfully requested.

If there are any questions regarding this Preliminary Amendment or this application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

It is respectfully requested that, if necessary to effect a timely response, this paper be considered as a Petition for an Extension of Time sufficient to effect a timely response and shortages in other fees, be charged, or any overpayment in fees be credited, to the Account of Evenson, McKeown, Edwards & Lenahan, P.L.L.C., Deposit Account No. 05-1323 (Docket #225/49630).

Respectfully submitted,

February 20, 2001

Donald D. Evenson
Registration No. 26,160

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Substitute Specification

SYNCHRONIZING DEVICE FOR A SHIFT TRANSMISSION

BACKGROUND AND SUMMARY OF THE INVENTION

[0001] This application claims the priority of German Patent Document 198 37 583.2, filed 19 August 1998 and PCT International Application PCT/EP99/04535, filed 1 July 1999, the disclosures of which is are expressly incorporated by reference herein.

[0002] The invention relates to a synchronizing device for a shift transmission, with at least one outer and one inner synchro ring and, if appropriate, an intermediate ring, the synchro rings and the intermediate ring in each case having conical surfaces, via which they are connected at least indirectly to one another, and at least one of the synchro rings and/or the intermediate ring consisting of a metallic basic material.

[0003] German Patent Document DE 31 22 522 A1 (corresponding U.S. Patent No. 4,618,049) discloses a generic synchronizing device.

[0004] In this case, a friction lining consisting of a non-metallic inorganic material is applied to one of the friction partners, to be precise either to a synchro ring or to a synchronizing ring, and is intended to improve the friction properties between the friction partners.

[0005] However, disadvantages of the method for producing this synchronizing device are that it is very costly and the applied friction lining has to be either applied extremely carefully or remachined after application. This leads to complicated manufacturing cycles and, furthermore, the friction lining may be damaged during pretreatment.

[0006] Another problem of this known synchronizing device is that particles, such as, for example, sulphur particles which reduce the coefficient of friction and are contained in the transmission oil may settle in the applied friction layer. As a result of these sulphur particles, the coefficient of friction between the friction partners is reduced, and therefore the applicable synchronizing torque or the synchronizing power of the shift transmission is diminished. This may ultimately lead to serious malfunctions of the transmission.

[0007] For the further prior art relating to synchronizing devices for shift transmissions, reference is made to French Patent Document FR 15 21 621 and Japanese Patent Document JP 2-304220 A.

[0008] The object of the present invention is to provide a synchronizing device for a shift transmission, which ensures uniform friction conditions between the friction partners and

which at the same time can be produced simply and cost-effectively.

[0009] This object is achieved, according to the invention, by a synchronizing device for a shift transmission, with at least one outer and one inner synchro ring and, if appropriate, at least one intermediate ring, the synchro rings and the intermediate ring in each case having conical surfaces, via which they are connected at least indirectly to one another, and at least one of the synchro rings and/or the intermediate ring consisting of a metallic basic material, wherein at least one of the synchro rings and the intermediate ring consists of metallic basic material which is nitride-hardened in such a way that, by process parameters being set during nitride-hardening, one of a non-metallic γ'-connecting layer and a non-metallic ε-connecting layer is formed on a conical surface of at least one of the synchro rings and the intermediate ring.

[0010] By means of the nitride hardening according to the invention of the synchro ring and/or of the intermediate ring consisting of the metallic basic material, as a result of which hardening a non-metallic γ'-connecting layer and/or a non-metallic ε-connecting layer is formed on the conical surface, for one of the friction partners in each case an outer frictional surface is obtained which has a constant coefficient of friction at a desired high level. In this case, the nitrided surface at

the same time has high hardness and high wear resistance associated with this. Furthermore, as a result of the nitride hardening, a non-hardened and therefore tough core remains, which ensures the strength of the respective component.

[0011] According to the invention, then, sulphur particles and other additives reducing the coefficient of friction can no longer penetrate into the γ'-connecting layer or into the ε-connecting layer, thus ensuring a uniformly high synchronizing moment. In order to form said connecting layers, it is necessary merely to change specific process parameters during nitride hardening, so that this layer is formed without an additional method step. Remachining of the corresponding connecting layer is advantageously no longer necessary. A very simple and cost-effective production of the synchronizing device is thus achieved.

[0012] In this case, the γ'-connecting layer or ε-connecting layer is firmly connected to the basic material of the synchro ring or of the intermediate ring, since it is not an injected-on or otherwise applied layer, but a layer produced by transformation from the basic material of the component.

[0013] Advantageous refinements and developments of the invention may be gathered from the subclaims and from the

exemplary embodiment illustrated in principle below with reference to the drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Figure 1 shows a highly diagrammatic illustration of part of a shift transmission with a synchronizing device according to the invention;

[0015] Figure 2 shows a top view of an outer synchro ring of the synchronizing device from Figure 1;

[0016] Figure 3 shows a section along the line III-III from Figure 2;

[0017] Figure 4 shows a top view of an inner synchro ring of the synchronizing device from Figure 1; and

[0018] Figure 5 shows a section along the line V-V from Figure 4.

DETAILED DESCRIPTION OF THE DRAWINGS

[0019] Figure 1 shows a shift transmission, for example for use in heavy goods vehicles or passenger cars, which is not illustrated in its entirety. The shift transmission has, in a way

known *per se*, a synchronizing device 1, a main shaft 2 and a gearwheel 3 mounted on the main shaft 2. Other gearwheels are also mounted on the main shaft 2, of course, but, since these are not relevant to the invention, they are not described below in any more detail. Nor is a countershaft conventionally used in the shift transmissions illustrated in Figure 1. A synchro body 4 is also located on the main shaft 2, in addition to the gearwheel 3, and is connected to a sliding fork 5 via a sliding sleeve 6 and a thrust pin 7. It is also possible, of course, for the components located on the main shaft 2 to be mounted on the countershaft.

[0020] The synchro body 4 is connected to the gearwheel 3 by the synchronizing device 1. For this purpose, the synchronizing device 1 consists of an outer synchro ring 8, an intermediate ring 9 and an inner synchro ring 10, the outer synchro ring 8 being connected to the synchro body 4 and the inner synchro ring 10 to the gearwheel 3. This design of the synchronizing device 1 is known per se and is also designated as Borg-Warner double-cone synchronization. Since the synchronization of the individual gearwheels of the shift transmission also proceeds in the same way in the present embodiment of the synchronizing device 1 as is known from the prior art, these sequences are not discussed in any more detail below.

[0021] The outer synchro ring 8 illustrated in more detail in Figures 2 and 3 has a conical surface 11 on its inside diameter, whereas the inner synchro ring 10 illustrated in Figures 4 and 5 is provided with a conical surface 12 on its outside diameter. The intermediate ring 9 arranged between the outer synchro ring 8 and the inner synchro ring 10 has an entirely conical design, that is to say both its outside diameter and its inside diameter are designed as conical surfaces 13 and 14 and are adapted to the conical surfaces 11 and 12 of the synchro rings 8 and 10. The synchronizing device 1 is provided for transmitting a force or a torque from the synchro body 4 to the gearwheel 3 via the outer synchro ring 8, the intermediate ring 9 and the inner synchro ring 10 by means of friction between the respective conical surfaces 11 to 14.

[0022] In order to achieved the desired coefficient of friction between the conical surface 13 on the outside diameter of the intermediate ring 9 and the conical surface 11 on the inside diameter of the outer synchro ring 8 and between the conical surface 14 of the intermediate ring 9 and the conical surface 12 of the inner synchro ring 10, the intermediate ring 9 is first provided on both conical surfaces 13 and 14 with a friction layer known *per se*.

[0023] Both the outer synchro ring 8 and the inner synchro ring 10 are nitride-hardened on their conical surfaces 11 and 12.

This nitride hardening is preferably carried out by means of a plasma-nitriding method, in which the process parameters are set such that non-metallic so-called γ'-connecting layers or ε-connecting layers are formed on the conical surfaces 11 and 12. For this purpose, the outer synchro ring 8 and the inner synchro ring 10 are introduced into a nitriding furnace, not illustrated, in which an ammonia atmosphere prevails. The process parameters to be set for the formation of the γ'-connecting layer or ε-connecting layer are, in this case, the temperature in the nitriding furnace, the gas mixture within the nitriding furnace, consisting of ammonia, hydrogen and carbon dioxide, the duration of the nitriding treatment, the vacuum prevailing in the nitriding furnace and the plasma which is necessary during plasma nitriding and which is controlled by a current and voltage. A layer is thus obtained in each case on the conical surfaces 11 and 12, which, on the one hand, is very hard and wear-resistant and into which, on the other hand, no additives, such as, for example, sulphur particles, contained in the transmission oil and reducing the coefficient of friction can infiltrate. As a result, a constant coefficient of friction is maintained continuously for the conical surfaces 11 and 12 and a uniform synchronizing torque can be transmitted by the synchronizing device 1.

[0024] The nitriding depth of the conical surfaces 11 and 12 is about 200 to 800 μm and the γ'-connecting layer or ε-connecting layer is approximately 1 to 20 μm, preferably

approximately 10 μm, thick. The γ'-connecting layer is an iron/nitrogen layer with the chemical designation Fe_4N. By contrast, the ε-connecting layer consists of the iron/nitrogen layer bearing the chemical designation $Fe_{2..3}N$.

[0025] Instead of the nitriding treatment of the outer synchro ring 8 and of the inner synchro ring 10, alternatively the intermediate ring 9 may also be nitride-hardened on its two conical surfaces 13 and 14 by means of the plasma-nitriding method, as described above, in this case, of course, the friction layer being applied to the conical surfaces 11 and 12 of the synchro rings 8 and 10. Furthermore, the principle of plasma-nitride hardening also operates with regard to single-cone synchronization without the intermediate ring 9, and, in this case, it is necessary merely to treat a conical surface of one of the two synchro rings 8 and 10 by means of a plasma-nitriding method.

[0026] The metallic basic material of the synchro rings 8 and 10 or of the intermediate ring 9 may be a sintered material, a sinter-forged material or else a hardenable steel, such as, for example, 16MnCr5, 31CrMoV9 or 34CrAlNi7. In the present exemplary embodiment, the synchro rings 8 and 10 are sintered parts. It is particularly advantageous to use molybdenum as a basic alloying element in these sintered materials, whereas, if steel materials

are used, the alloying constituents chromium, molybdenum, aluminium and manganese lead to very good results.

[0027] Instead of plasma nitriding, if appropriate the nitriding methods used may also be long-term gas nitriding or short-term gas nitriding.

[0028] Of course, the synchronizing device 1 could also be designed for single-cone synchronization or for three-cone or multiple-cone synchronization, instead of for Borg-Warner double-cone synchronization.

[0029] In single-cone synchronization according to the Borg-Warner system, there would be no intermediate ring 9 provided, the outer synchro ring 8 would be produced in one part with the gearwheel 3 and the inner synchro ring 8 would be connected to the synchro body 4. The γ'-connecting layer or the ε-connecting layer would then be provided on one of the two synchro rings 8 or 10 and the friction layer on the other.

[0030] In further possible single-cone synchronization, the conical surface 11 could be mounted on the sliding sleeve 6, in which case the inner synchro ring 10 would be mounted loosely on the gearwheel 3. The γ'-connecting layer or the ε-connecting layer and the friction layer could then be applied to the conical

surface 11 of the sliding sleeve 6 or to the conical surface 12 of the inner synchro ring 10.

[0031] In the case of triple-cone synchronization, two intermediate rings 9 would have to be provided, in which case the γ'-connecting layer or the ε-connecting layer and the friction layer would have to be applied in accordance with the embodiments mentioned above. In the case of multiple-cone synchronization, a correspondingly larger number of intermediate rings 9 is necessary.

PATENT CLAIMS

1. Synchronizing device for a shift transmission, with at least one outer and one inner synchro ring and, if appropriate, at least one intermediate ring, the synchro rings and the intermediate ring in each case having conical surfaces, via which they are connected at least indirectly to one another, and at least one of the synchro rings and/or the intermediate ring consisting of a metallic basic material, characterized in that at least one of the synchro rings (8, 10) and/or the intermediate ring (9) consisting of the metallic basic material being nitride-hardened in such a way that, by process parameters being set during nitride-hardening, a non-metallic γ'-connecting layer and/or a non-metallic ε-connecting layer is formed on the conical surface (11, 12) of the synchro ring (8, 10) and/or on the conical surface (13, 14) of the intermediate ring (9).

2. Synchronizing device according to Claim 1, characterized in that the γ'-connecting layer consists of Fe_4N.

3. Synchronizing device according to Claim 1 or 2, characterized in that the ε-connecting layer consists of $Fe_{2,3}N$.

4. Synchronizing device according to Claim 1, 2 or 3, characterized in that the at least one synchro ring (8, 10) and/or the intermediate ring (9) is plasma-nitride-hardened.

5. Synchronizing device according to one of Claims 1 to 4, characterized in that the metallic basic material of the at least one synchro ring (8, 10) and/or of the intermediate ring (9) is a sintered material.

6. Synchronizing device according to one of Claims 1 to 4, characterized in that the metallic basic material of the at least one synchro ring (8, 10) and/or of the intermediate ring (9) is a sinter-forged material.

7. Synchronizing device according to one of Claims 1 to 4, characterized in that the metallic basic material of the at least one synchro ring (8, 10) and/or of the intermediate ring (9) is a hardenable steel.

8. Synchronizing device according to one of Claims 1 to 7, characterized in that the nitriding depth is 200 to 800 μm.

9. Synchronizing device according to one of Claims 1 to 8, characterized in that the γ'-connecting layer or the ε-connecting layer is 1 to 20 μm, preferably approximately 10 μm, thick.

10. Synchronizing device according to one of Claims 1 to 9, characterized in that the intermediate ring (9) is arranged between the inner synchro ring (10) and the outer synchro

ring (8), the conical surfaces (13, 14) of the intermediate ring (9) having a friction layer, and the γ'- or ε-connecting layer being in each case located on the conical surfaces (11, 12) of the two synchro rings (8, 10) in the outer region.

11. Synchronizing device according to one of Claims 1 to 9, characterized in that the inner synchro ring (10) or the outer synchro ring (8) is firmly connected to the gearwheel (3), the γ'- or ε-connecting layer being applied to one synchro ring (8, 10), and the friction layer being applied to the other synchro ring (8, 10).

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Synchronizing device for a shift transmission

The invention relates to a synchronizing device for a shift transmission, with at least one outer and one inner synchro ring and, if appropriate, an intermediate ring, of the type defined in more detail in the pre-characterizing clause of Claim 1.

DE 31 22 522 A1 discloses a generic synchronizing device.

In this case, a friction lining consisting of a non-metallic inorganic material is applied to one of the friction partners, to be precise either to a synchro ring or to a synchronizing ring, and is intended to improve the friction properties between the friction partners.

However, disadvantages of the method for producing this synchronizing device are that it is very costly and the applied friction lining has to be either applied extremely carefully or remachined after application. This leads to complicated manufacturing cycles and, furthermore, the friction lining may be damaged during retreatment.

Another problem of this known synchronizing device is that particles, such as, for example, sulphur particles which reduce the coefficient of friction and are contained in the transmission oil may settle in the applied friction layer. As a

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result of these sulphur particles, the coefficient of friction between the friction partners is reduced, and therefore the applicable synchronizing torque or the synchronizing power of the shift transmission is diminished. This may ultimately lead to serious malfunctions of the transmission.

For the further prior art relating to synchronizing devices for shift transmissions, reference is made to FR 15 21 621 and JP 2-304220 A.

The object of the present invention is to provide a synchronizing device for a shift transmission, which ensures uniform friction conditions between the friction partners and which at the same time can be produced simply and cost-effectively.

This object is achieved, according to the invention, by means of the features mentioned in the characterizing clause of Claim 1.

By means of the nitride hardening according to the invention of the synchro ring and/or of the intermediate ring consisting of the metallic basic material, as a result of which hardening a non-metallic γ'-connecting layer and/or a non-metallic ε-connecting layer is formed on the conical surface, for one of the friction partners in each case an outer frictional surface is obtained which has a constant coefficient of friction at a desired high level. In this case, the nitrided surface at the same time has high hardness and high wear resistance

associated with this. Furthermore, as a result of the nitride hardening, a non-hardened and therefore tough core remains, which ensures the strength of the respective component.

According to the invention, then, sulphur particles and other additives reducing the coefficient of friction can no longer penetrate into the γ'-connecting layer or into the ε-connecting layer, thus ensuring a uniformly high synchronizing moment. In order to form said connecting layers, it is necessary merely to change specific process parameters during nitride hardening, so that this layer is formed without an additional method step. Remachining of the corresponding connecting layer is advantageously no longer necessary. A very simple and cost-effective production of the synchronizing device is thus achieved.

In this case, the γ'-connecting layer or ε-connecting layer is firmly connected to the basic material of the synchro ring or of the intermediate ring, since it is not an injected-on or otherwise applied layer, but a layer produced by transformation from the basic material of the component.

Advantageous refinements and developments of the invention may be gathered from the subclaims and from the exemplary embodiment illustrated in principle below with reference to the drawing in which:

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Figure 1 shows a highly diagrammatic illustration of part of a shift transmission with a synchronizing device according to the invention;

Figure 2 shows a top view of an outer synchro ring of the synchronizing device from Figure 1;

Figure 3 shows a section along the line III-III from Figure 2;

Figure 4 shows a top view of an inner synchro ring of the synchronizing device from Figure 1; and

Figure 5 shows a section along the line V-V from Figure 4.

Figure 1 shows a shift transmission, for example for use in heavy goods vehicles or passenger cars, which is not illustrated in its entirety. The shift transmission has, in a way known per se, a synchronizing device 1, a main shaft 2 and a gearwheel 3 mounted on the main shaft 2. Other gearwheels are also mounted on the main shaft 2, of course, but, since these are not relevant to the invention, they are not described below in any more detail. Nor is a countershaft conventionally used in the shift transmissions illustrated in Figure 1. A synchro body 4 is also located on the main shaft 2, in addition to the gearwheel 3, and is connected to a sliding fork 5 via a sliding sleeve 6

and a thrust pin 7. It is also possible, of course, for the components located on the main shaft 2 to be mounted on the countershaft.

The synchro body 4 is connected to the gearwheel 3 by the synchronizing device 1. For this purpose, the synchronizing device 1 consists of an outer synchro ring 8, an intermediate ring 9 and an inner synchro ring 10, the outer synchro ring 8 being connected to the synchro body 4 and the inner synchro ring 10 to the gearwheel 3. This design of the synchronizing device 1 is known per se and is also designated as Borg-Warner double-cone synchronization. Since the synchronization of the individual gearwheels of the shift transmission also proceeds in the same way in the present embodiment of the synchronizing device 1 as is known from the prior art, these sequences are not discussed in any more detail below.

The outer synchro ring 8 illustrated in more detail in Figures 2 and 3 has a conical surface 11 on its inside diameter, whereas the inner synchro ring 10 illustrated in Figures 4 and 5 is provided with a conical surface 12 on its outside diameter. The intermediate ring 9 arranged between the outer synchro ring 8 and the inner synchro ring 10 has an entirely conical design, that is to say both its outside diameter and its inside diameter are designed as conical surfaces 13 and 14 and are adapted to the conical surfaces 11 and 12 of the synchro rings 8 and 10. The synchronizing device 1 is provided for transmitting a force or

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a torque from the synchro body 4 to the gearwheel 3 via the outer synchro ring 8, the intermediate ring 9 and the inner synchro ring 10 by means of friction between the respective conical surfaces 11 to 14.

In order to achieved the desired coefficient of friction between the conical surface 13 on the outside diameter of the intermediate ring 9 and the conical surface 11 on the inside diameter of the outer synchro ring 8 and between the conical surface 14 of the intermediate ring 9 and the conical surface 12 of the inner synchro ring 10, the intermediate ring 9 is first provided on both conical surfaces 13 and 14 with a friction layer known per se.

Both the outer synchro ring 8 and the inner synchro ring 10 are nitride-hardened on their conical surfaces 11 and 12. This nitride hardening is preferably carried out by means of a plasma-nitriding method, in which the process parameters are set such that non-metallic so-called γ'-connecting layers or ε-connecting layers are formed on the conical surfaces 11 and 12. For this purpose, the outer synchro ring 8 and the inner synchro ring 10 are introduced into a nitriding furnace, not illustrated, in which an ammonia atmosphere prevails. The process parameters to be set for the formation of the γ'-connecting layer or ε-connecting layer are, in this case, the temperature in the nitriding furnace, the gas mixture within the nitriding furnace, consisting of ammonia, hydrogen and carbon dioxide, the duration

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of the nitriding treatment, the vacuum prevailing in the nitriding furnace and the plasma which is necessary during plasma nitriding and which is controlled by a current and voltage. A layer is thus obtained in each case on the conical surfaces 11 and 12, which, on the one hand, is very hard and wear-resistant and into which, on the other hand, no additives, such as, for example, sulphur particles, contained in the transmission oil and reducing the coefficient of friction can infiltrate. As a result, a constant coefficient of friction is maintained continuously for the conical surfaces 11 and 12 and a uniform synchronizing torque can be transmitted by the synchronizing device 1.

The nitriding depth of the conical surfaces 11 and 12 is about 200 to 800 μm and the γ'-connecting layer or ε-connecting layer is approximately 1 to 20 μm, preferably approximately 10 μm, thick. The γ'-connecting layer is an iron/nitrogen layer with the chemical designation Fe_4N. By contrast, the ε-connecting layer consists of the iron/nitrogen layer bearing the chemical designation $Fe_{2-3}N$.

Instead of the nitriding treatment of the outer synchro ring 8 and of the inner synchro ring 10, alternatively the intermediate ring 9 may also be nitride-hardened on its two conical surfaces 13 and 14 by means of the plasma-nitriding method, as described above, in this case, of course, the friction layer being applied to the conical surfaces 11 and 12 of the synchro rings 8 and 10. Furthermore, the principle of plasma-

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nitride hardening also operates with regard to single-cone synchronization without the intermediate ring 9, and, in this case, it is necessary merely to treat a conical surface of one of the two synchro rings 8 and 10 by means of a plasma-nitriding method.

The metallic basic material of the synchro rings 8 and 10 or of the intermediate ring 9 may be a sintered material, a sinter-forged material or else a hardenable steel, such as, for example, 16MnCr5, 31CrMoV9 or 34CrAlNi7. In the present exemplary embodiment, the synchro rings 8 and 10 are sintered parts. It is particularly advantageous to use molybdenum as a basic alloying element in these sintered materials, whereas, if steel materials are used, the alloying constituents chromium, molybdenum, aluminium and manganese lead to very good results.

Instead of plasma nitriding, if appropriate the nitriding methods used may also be long-term gas nitriding or short-term gas nitriding.

Of course, the synchronizing device 1 could also be designed for single-cone synchronization or for three-cone or multiple-cone synchronization, instead of for Borg-Warner double-cone synchronization.

In single-cone synchronization according to the Borg-Warner system, there would be no intermediate ring 9 provided, the outer synchro ring 8 would be produced in one part with the gearwheel 3 and the inner synchro ring 8 would be connected to

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the synchro body 4. The γ'-connecting layer or the ε-connecting layer would then be provided on one of the two synchro rings 8 or 10 and the friction layer on the other.

In further possible single-cone synchronization, the conical surface 11 could be mounted on the sliding sleeve 6, in which case the inner synchro ring 10 would be mounted loosely on the gearwheel 3. The γ'-connecting layer or the ε-connecting layer and the friction layer could then be applied to the conical surface 11 of the sliding sleeve 6 or to the conical surface 12 of the inner synchro ring 10.

In the case of triple-cone synchronization, two intermediate rings 9 would have to be provided, in which case the γ'-connecting layer or the ε-connecting layer and the friction layer would have to be applied in accordance with the embodiments mentioned above. In the case of multiple-cone synchronization, a correspondingly larger number of intermediate rings 9 is necessary.

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DaimlerChrysler AG

Stuttgart

Patent Claims

1. Synchronizing device for a shift transmission, with at least one outer and one inner synchro ring and, if appropriate, at least one intermediate ring, the synchro rings and the intermediate ring in each case having conical surfaces, via which they are connected at least indirectly to one another, and at least one of the synchro rings and/or the intermediate ring consisting of a metallic basic material, characterized in that at least one of the synchro rings (8, 10) and/or the intermediate ring (9) consisting of the metallic basic material being nitride-hardened in such a way that, by process parameters being set during nitride-hardening, a non-metallic γ'-connecting layer and/or a non-metallic ε-connecting layer is formed on the conical surface (11, 12) of the synchro ring (8, 10) and/or on the conical surface (13, 14) of the intermediate ring (9).

2. Synchronizing device according to Claim 1, characterized in that the γ'-connecting layer consists of Fe_4N.

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3. Synchronizing device according to Claim 1 or 2, characterized in that the ε-connecting layer consists of $Fe_{2.3}N$.

4. Synchronizing device according to Claim 1, 2 or 3, characterized in that the at least one synchro ring (8, 10) and/or the intermediate ring (9) is plasma-nitride-hardened.

5. Synchronizing device according to one of Claims 1 to 4, characterized in that the metallic basic material of the at least one synchro ring (8, 10) and/or of the intermediate ring (9) is a sintered material.

6. Synchronizing device according to one of Claims 1 to 4, characterized in that the metallic basic material of the at least one synchro ring (8, 10) and/or of the intermediate ring (9) is a sinter-forged material.

7. Synchronizing device according to one of Claims 1 to 4, characterized in that the metallic basic material of the at least one synchro ring (8, 10) and/or of the intermediate ring (9) is a hardenable steel.

8. Synchronizing device according to one of Claims 1 to 7, characterized in that the nitriding depth is 200 to 800 μm.

9. Synchronizing device according to one of Claims 1 to 8, characterized in that the γ'-connecting layer or the ε-connecting layer is 1 to 20 μm, preferably approximately 10 μm, thick.

10. Synchronizing device according to one of Claims 1 to 9, characterized in that the intermediate ring (9) is arranged between the inner synchro ring (10) and the outer synchro ring (8), the conical surfaces (13, 14) of the intermediate ring (9) having a friction layer, and the γ'- or ε-connecting layer being in each case located on the conical surfaces (11, 12) of the two synchro rings (8, 10) in the outer region.

11. Synchronizing device according to one of Claims 1 to 9, characterized in that the inner synchro ring (10) or the outer synchro ring (8) is firmly connected to the gearwheel (3), the γ'- or ε-connecting layer being applied to one synchro ring (8, 10), and the friction layer being applied to the other synchro ring (8, 10).

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DaimlerChrysler AG

Stuttgart

Abstract

Synchronizing device for a shift transmission

A synchronizing device for a shift transmission is provided with at least one outer and one inner synchro ring and, if appropriate, at least one intermediate ring. The synchro rings and the intermediate ring in each case have conical surfaces, via which they are connected at least indirectly to one another. At least one of the synchro rings and/or the intermediate ring consists of a metallic basic material. At least one of the synchro rings and/or the intermediate ring consisting of the metallic basic material is nitride-hardened in such a way that, by process parameters being set during nitride-hardening, a non-metallic γ'-connecting layer and/or a non-metallic ε-connecting layer is formed on the conical surface of the synchro ring and/or on the conical surface of the intermediate ring.

ABSTRACT OF THE DISCLOSURE

A synchronizing device for a shift transmission is provided with at least one outer and one inner synchro ring and, if appropriate, at least one intermediate ring. The synchro rings and the intermediate ring in each case have conical surfaces, via which they are connected at least indirectly to one another. At least one of the synchro rings and/or the intermediate ring consists of a metallic basic material. At least one of the synchro rings and/or the intermediate ring consisting of the metallic basic material is nitride-hardened in such a way that, by process parameters being set during nitride-hardening, a non-metallic γ'-connecting layer and/or a non-metallic ε-connecting layer is formed on the conical surface of the synchro ring and/or on the conical surface of the intermediate ring.

Fig. 1

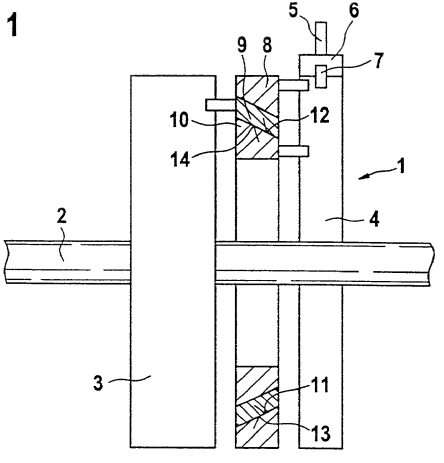


Fig. 2

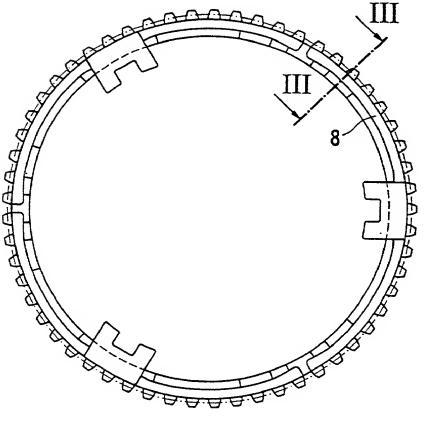


Fig. 3

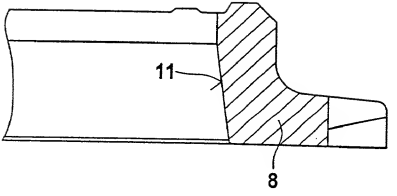


Fig. 4

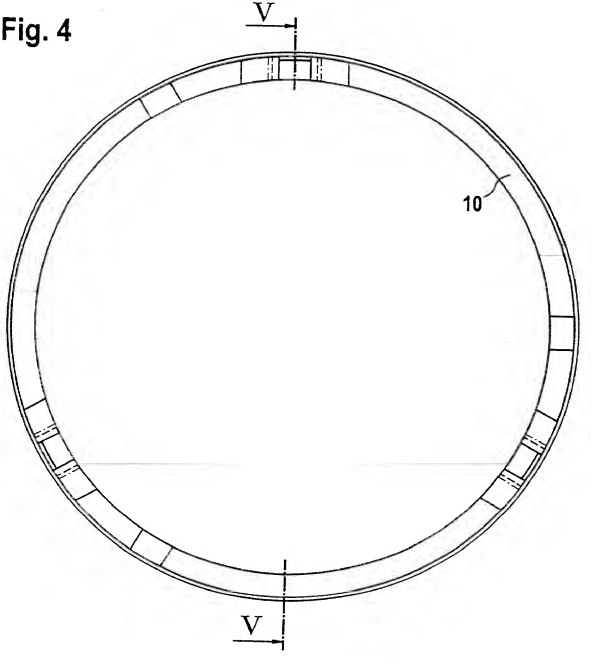
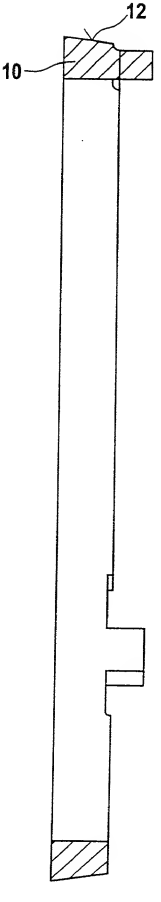


Fig. 5



COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (includes Reference to PCT International Applications)	ATTORNEY'S DOCKET NUMBER 225/49630

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SYNCHRONIZING DEVICE FOR A SHIFT TRANSMISSION

the specification of which (check only one item below):

[X] is attached hereto.

[ ] was filed as United States application
Serial No. _____
on _____
and was amended
on _____ (if applicable).

[X] was filed as PCT international application
Number PCT/EP99/04535
on 01 July 1999
and was amended under PCT Article 19
on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations. §1.56(a).

I hereby claim foreign priority benefits under Title 35, United State Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (if PCT indicate PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
Germany	198 37 583.2	19 August 1998	[X] Yes [ ] No
PCT	EP99/04535	01 July 1999	[X] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No

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(includes Reference to PCT international Applications

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I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national of PCT international filing date of this application:

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U.S APPLICATIONS		STATUS *(Check one)*		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (IF ANY)			

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration number)

Herbert I. Cantor, Reg. No. 24,392; James F. McKeown, Reg. No. 25,406; Donald D. Evenson, Reg. No. 26,160; Joseph D. Evans, Reg. No. 26,269; Gary R. Edwards, Reg. No. 31,824; and Jeffrey D. Sanok, Reg. No. 32,169

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201	FULL NAME OF INVENTOR	FAMILY NAME **MAIER**	FIRST GIVEN NAME **Winfried**	SECOND GIVEN NAME
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	POST OFFICE ADDRESS	POST OFFICE ADDRESS **Langaeckerweg 2**	CITY **Gaggenau**	STATE & ZIP CODE/COUNTRY **D-76571 GERMANY**
202	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
203	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true: and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE	Date	DATE

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
(includes Reference to PCT International Applications)

ATTORNEY'S DOCKET NUMBER
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As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SYNCHRONIZING DEVICE FOR A SHIFT TRANSMISSION

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			[ ] Yes [ ] No
			[ ] Yes [ ] No
			[ ] Yes [ ] No

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(includes Reference to PCT international Applications

ATTORNEY'S DOCKET NUMBER
225/49630

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national of PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120

U.S. APPLICATIONS		STATUS *(Check one)*		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.

PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (IF ANY)			

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration number)

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201	FULL NAME OF INVENTOR	FAMILY NAME **MAIER**	FIRST GIVEN NAME **Winfried**	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY ~~karlsruhe~~ ~~Guggenau~~	STATE OR FOREIGN COUNTRY **Germany**	COUNTRY OF CITIZENSHIP **Germany**
	POST OFFICE ADDRESS	POST OFFICE ADDRESS ~~Uhlandstrasse 14~~ ~~Langackerweg 2~~	CITY **Gaggenau**	STATE & ZIP CODE/COUNTRY ~~76135~~ **D-76571 GERMANY**
202	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
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	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
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	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
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13.03.01

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true: and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE 13.03.01	Date	DATE